(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1112 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. I) ODD SEMESTER THEORY EXAMINATION 2013-14

ENGINEERING MECHANICS

Time : 3 Hours *Total Marks : 100*

Note :– (i) This paper is in **three** Sections. Section A carries **20** marks. Section B carries **30** marks and Section C carries **50** marks.

(ii) Attempt **all** questions. Marks are indicated against each question.

(iii) Assume missing data suitably if any.

SECTION–A **(2×10=20)**

1. Attempt **all** parts of this question. Each part carries 2 marks.

(a) Write the conditions of equilibrium for co-planar force system.

(b) State Lami Theorem.

(c) Define the following :

(i) Coefficient of friction

(ii) Angle of repose.

(d) What are the various types of truss ?

(e) Define the following :

(i) Mechanical advantage

(ii) Velocity ratio.

(f) What do you mean by Polar Moment of Inertia ?

(g) Differentiate between kinematics and kinetics.

(h) Write the equations of motion.

(i) Explain work energy principle.

(j) Write down the principle of impulse and momentum.

SECTION–B (10×3=30)

2. Attempt any **three** parts of this question. Each part carries 10 marks.

(a) Three smooth cylinder each of radius 30 cm and weight 150 N placed in a rectangular channel of width 150 cm as shown in fig. 1. Determine the reactions at all contact surfaces.

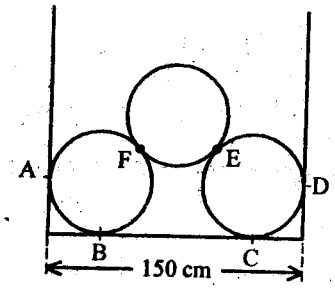

Fig. 1

(b) Bodies 'A' and 'B' weighing 500 N and 300 N respectively are placed on an inclined plane as shown in figure 2. The plane on which they are placed is raised from the horizontal position to an angle θ. What is the maximum angle that can be reached before the body is slip down the incline.

Take M_s for the body 'B' and plane is 0.2 and that between body 'A' and plane is 0.3.

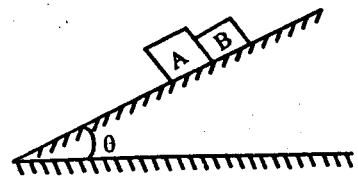

Fig. 2

(c) Compute the moment of inertia of 'L' section as shown in fig. 3 about its centroidal axis.

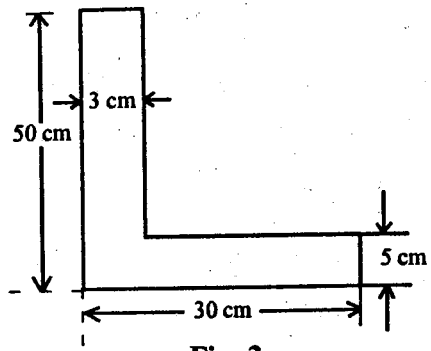

Fig. 3

(d) The acceleration of a particle in rectilinear motion is defined by the relation $a = 3t^2 + 2$. Given that the initial velocity and displacement are respectively 2 m/s and 3 m. Write the equations of motion. Also determine the position, velocity and acceleration at $t = 5s$.

(e) A 40 N-m couple moment is applied to a wheel that rest on a plane and has 20 kg mass and 0.4 m radius of gyration as shown in fig. 4. If the coefficient of friction between wheel and plane is 0.25, determine :

(i) Acceleration of centre of mass of wheel

(ii) Frictional force.

Assume radius for the wheel is 0.8 m.

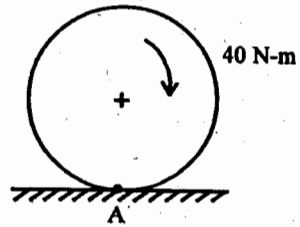

Fig. 4

SECTION–C

3. Attempt any **one** of the following : **(10×1=10)**

(a) A frictionless pulley is supported by two bars AB and AC which are hinged at B and C to A vertical wall as shown in fig. 5. A flexible cable DG hinged at 'D' goes over the pulley and supports a load of 15 kN at G. Determine the forces in the bars AB and AC.

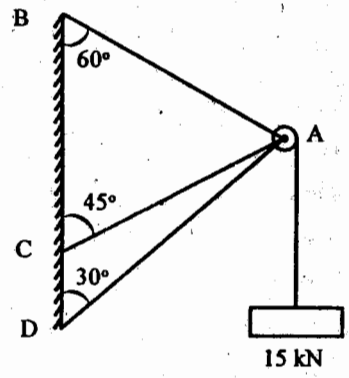

Fig. 5

(b) A sphere is resting on a smooth V shaped groove subjected to a spring force. The spring is compressed to a length of

100 m from the free length of 150 mm, if the stiffness of spring is 2 N/mm, determine contact reactions A and B as shown in fig. 6.

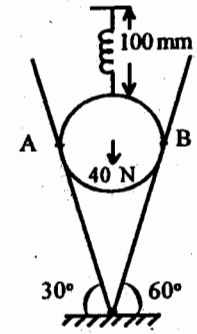

Fig. 6

mpt any **one** of the following : **(10×1=10)**

Determine the forces in each member of truss as shown in fig. 7.

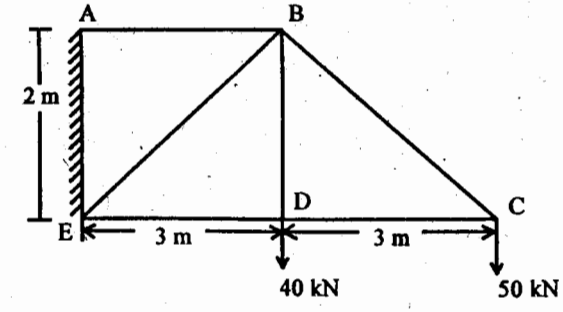

Fig. 7

Derive the expression for the length of belt required in an open belt drive.

5. Attempt any **one** of the following : **(10×1=10)**

(a) (i) Derive the expression for centroid of a semicircular arc.

(ii) Derive the expression for moment of inertia of a triangle about its base.

(b) Calculate the MOI of a composite section as shown in fig. 8, about centroidal axis.

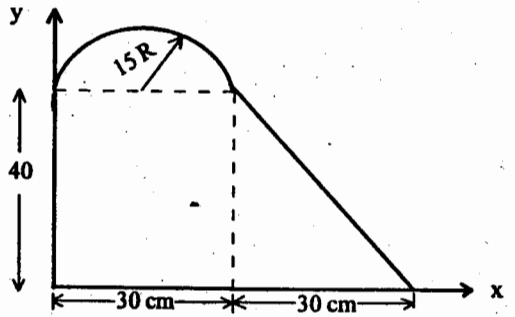

Fig. 8

6. Attempt any **one** of the following : **(10×1=10)**

(a) A stone is dropped into a well and the splash heard after 3 seconds. If speed of sound in air is 30 m/sec, determine depth of well.

(b) (i) A ladder AB = 3 m long slides so that its ends remain in contact with the vertical wall and horizontal floor. If end A slides with linear velocity 10 cm/sec, find the velocity of upper end B and angular velocity of ladder.

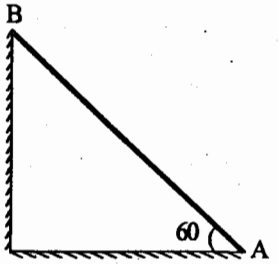

Fig. 9

(ii) A flywheel rotates about a fixed axis at 240 rpm is uniformly accelerated for 60 sec during which it turns 320 revolutions. Find the angular velocity at the end of this interval. Also find time required for the velocity to reach 450 rpm.

Attempt any **one** of the following : **(10×1=10)**

(a) A drum as shown in fig. 10 has a radius of gyration of 30 cm and weight 1.8 kN. It is supported by means of small hubs which raise in bearing. A weight 1 kN is attached to one end of the rope. The other end is wrapped around the drum. Neglecting friction in the bearing, determine the acceleration of weight, angular acceleration of drum and tension in the rope.

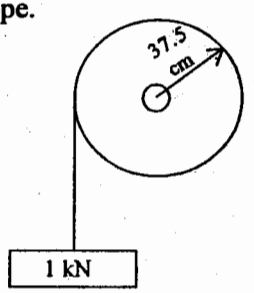

Fig. 10

(b) Find the expression for the acceleration of the system, as shown in fig. 11. If $m_1 = 2$ kg, $m_2 = 1$ kg, $\theta = 30°$ and $M = 0.2$ for all contact surfaces. Determine tension in the string and acceleration of the system. Assume pulley is massless and frictionless and string is inextensible.

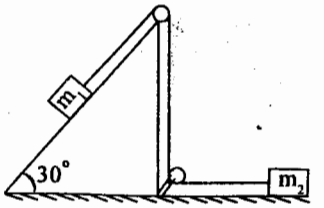

Fig. 11